



Gunpowder Creek Watershed Hydromodification Report

Gunpowder Watershed Initiative Steering Committee
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Gunpowder Creek Watershed Initiative

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In collaboration with the Gunpowder Creek Watershed Initiative, this Hydromodification Report presents the findings from hydrogeomorphic survey data at sites throughout the Gunpowder Creek Watershed. It complements the Kentucky Division of Water (KDOW) "report card" approach presented in the *Gunpowder Creek Watershed Health Report – Phase II* document.

Hydromodification and channel instability is a significant source of sediment in the Gunpowder Creek stream network, and sediment pollution was the number one water quality impairment as documented by concentrations of total suspended solids (TSS) presented in the Water Quality Data Analysis Report.

What is Hydromodification?

As one of the leading sources of impairment in streams across the United States, hydromodification includes channelization (stream

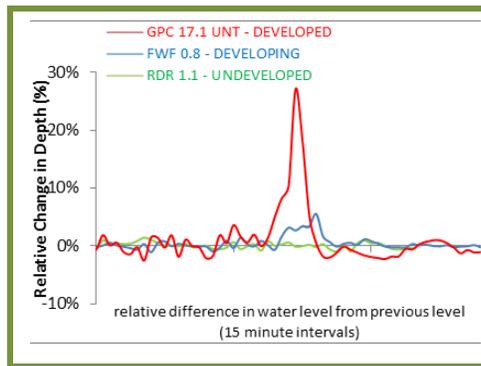
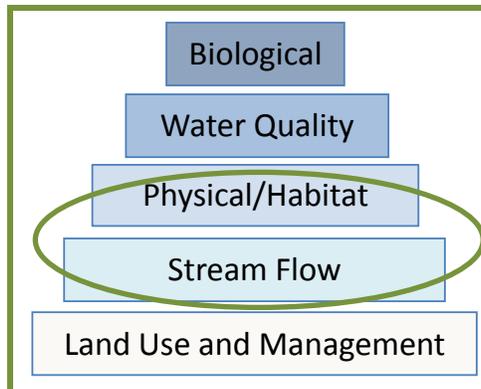
straightening), construction of dams, and streambank erosion caused by erosive stormwater runoff (EPA, 2010). All of these actions can affect downstream channel stability, resulting in wider channels through bank erosion and deeper channels through incision of the channel bed. Such instabilities greatly impact the overall stream function pyramid, as stream flow and physical attributes of the stream system are important for sustaining aquatic habitat, maintaining water quality, and promoting the presence of biological species (top center figure adapted from Center for Watershed Protection).

How does the urban flow regime impact channel stability? The most prominent cause of hydromodification in the Gunpowder Creek Watershed includes the erosive urban flow regime associated with conventional watershed development, specifically in the upstream reaches. As one of the most rapidly developing counties in the state of Kentucky, Boone

County's watersheds are experiencing the negative impacts associated with conventional development practices.

Data logger information was compared for three sites within the Gunpowder Creek Watershed that had similar drainage areas but varying levels of development. The information supports that the altered flow regime associated with conventional urban development leads to flashier and larger flows. This is demonstrated in the

chart above by comparing the most developed site (red) to the other two sites. The most developed site experienced much higher and more rapid changes in water levels during the same rain event compared to the other two data logger locations. Stability and habitat quality tend to decrease in developed watersheds and impervious area has been strongly correlated to channel enlargement, bed coarsening, shorter riffles, and deeper, longer pools in Northern Kentucky streams (Hawley *et al.*, In review).



Case studies and stability analysis document the problem of hydromodification throughout the watershed.

Through several years of hydromodification monitoring, the streams throughout the Gunpowder Creek Watershed tend to document familiar trends of instability. A few case studies presented below highlight some of the issues facing the watershed. Additionally, we present the average annual change in stream channel area, an overall stability rating, as determined by the Sanitation District No. 1 of Northern Kentucky's Stability Index, and a corresponding letter grade for each site in the Figure below. This illustrates that instability is a problem throughout the watershed as no sites performed better than a 7 out of 10 for the Stability Index (or a corresponding grade of a B+).

HYDROMODIFICATION CASE STUDIES DOCUMENT PHYSICAL CHANGES



Tension crack bank failure along the entire length of the bank in the South Fork subwatershed at monitoring site SFG 5.3-UNT 0.1.



Also in the South Fork subwatershed (site SFG 5.3-DS), the erosive flow regime has caused the banks to enlarge, particularly the left bank, which has expanded more than 3 feet, resulting in the loss of two trees (red). It has also caused bedrock incision as the stream bed continues to deepen (yellow).



GUNPOWDER CREEK WATERSHED HYDROMODIFICATION SUMMARY

OVERALL STABILITY SCORE/GRADE: 3.5 / C

